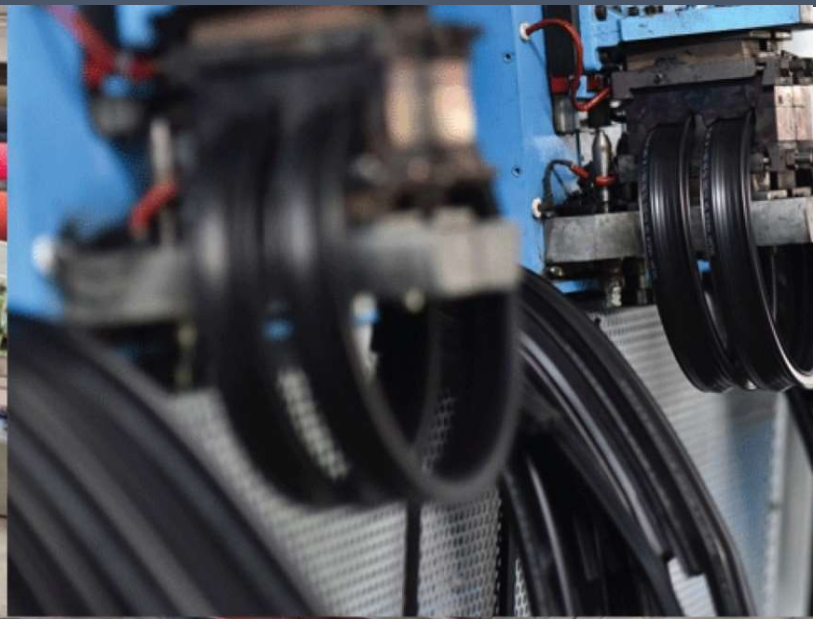


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**Continuous Rotary Drum Heating for  
Drying of Barley Husk**

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Customer :	M/s. Hindustan Unilever Ltd.
Process :	Continuous Rotary Drum Heating for Drying of Barley Husk

**Test Report No: 187/KRDC/LAB/17 Mum 24/10/2023**

Date Sample reception : 21/02/2023  
ID : 187/LAB/24

**Sample Description:**

Sampling : As Requested  
Sample Condition : Acceptable  
Sampling date : 23/02/2023  
Product : Barley Husk  
Start Date test : 23/02/2023  
End Date test : 23/02/2023

**Laboratory Experimental System –**





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### System Specifications –

<b>Heating Power</b>	5 kW
<b>Type of Heating Element</b>	Air Heaters
<b>Rotary Drum Size</b>	Φ324 mm x 800 mm long x 3mm Thick.
<b>Thermal Monitoring System</b>	Single Channel Fiber Optic: Range -40 to 250°C
<b>Exhaust</b>	Exhaust port with manual damper
<b>Air Circulation Fan</b>	Radial Fan FHP 0.5HP

### Laboratory's Environmental Conditions –





<b>Temperature (degree C)</b>	29.4°C (±5°C)
<b>Humidity (%)</b>	≤50% RH
<b>Pressure (kN/m<sup>2</sup> or kPa)</b>	Not recorded

**Note for recommendation:** Environmental conditions have a direct impact on test results. Accuracy and consistency of test data are affected by the laboratory conditions

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### Equipment Used -

Name of Equipment	Picture of Equipment	Specifications
<b>Compact Thermal Imaging Camera</b>		<b>Model: FLIR E-30</b> <b>Resolution: 160x 120IR Thermal</b> <b>sensitivity of 0.10°C</b>
<b>Thermo Hygrometer</b>		<b>Model No: HTC-2</b> <b>Temperature accuracy: <math>\pm^{\circ}\text{C}</math> (1.8°F)</b> <b>Temperature resolution: 0.1°C (0.2°F)</b>  <b>Humidity range: 10%~99% RH</b> <b>Humidity accuracy: <math>\pm 5\%</math> RH</b> <b>Humidity resolution: 1% RH</b>
<b>Moisture Analyzer</b>		<b>Make: Axis Balance</b> <b>Description:</b> <b>Moisture range: 1%(sample 0.02/0.05g),</b> <b>0.1% (Sample 0.5/5g),</b> <b>0.01%(Sample&gt;5g)</b>
<b>Screw press machine</b>		<b>Dewatering</b> <b>Automation: Manual</b> <b>Capacity: 3 liter</b>

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**Procedure of the Experiment -**

- The experiment was performed on Barley Husk to speed up the heating rate.
- For this experimental run, the given sample was taken and then passed in the Continuous Rotary Drum Heating System with suitable parameters.
- After the heating treatment, the sample was analyzed.

**Analytical Results:**

**Trials 1 –**

Initial Weight – 1000g

Initial Moisture – 70.9%

Moisture after screw press – 53.3%

<b>Trials</b>	<b>Cycle time</b>	<b>Initial Moisture</b>	<b>System Specifications</b>	<b>Final Moisture</b>	<b>On product temp</b>	<b>Remark</b>
C1	After 20 mins.	53.3%	Set temp:150°C; Drum speed: 0.3rpm	21.9%	(55-63)	Drying Started
C2	After 40 mins.	21.9%	Set temp:150°C; Drum speed: 0.3rpm	15.8%	(55-65)	Drying continuous
C3	After 60 mins.	15.8%	Set temp:150°C; Drum speed: 0.3rpm	8.7%	(65-74)	Dried as desired

Final Weight – 223g

Final Moisture – 8.7%

No. of Cycles – 3

Total Cycle time – 60 mins.

**Trials 2 –**

Initial Weight – 1000g

Initial Moisture – 70.9%

Moisture after screw press – 53.3%

<b>Trials</b>	<b>Cycle time</b>	<b>Initial Moisture</b>	<b>System Specifications</b>	<b>Final Moisture</b>	<b>On product temp</b>	<b>Remark</b>
C1	After 25 mins.	53.3%	Set temp:150°C; Drum speed: 0.2rpm	15%	(80-90)	Drying started
	After 25 mins.	15%	Set temp:150°C; Drum speed: 0.2rpm	7.2%	(93-97)	Dried as desired

Final Weight – 214g

Final Moisture – 7.2%

No. of Cycles – 2

Total Cycle time – 50 mins.

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**Trials 3 –**

Initial Weight – 1000g

Initial Moisture – 70.9%

Moisture after screw press – 53.3%

Trials	Cycle time	Initial Moisture	System Specifications	Final Moisture	On product temp	Remark
C1	After 40 mins.	53.3%	Set temp:150°C; Drum speed: 0.1rpm	7.5%	(93-104)	Drying Started

Final Weight – 211g

Final Moisture – 7.5%

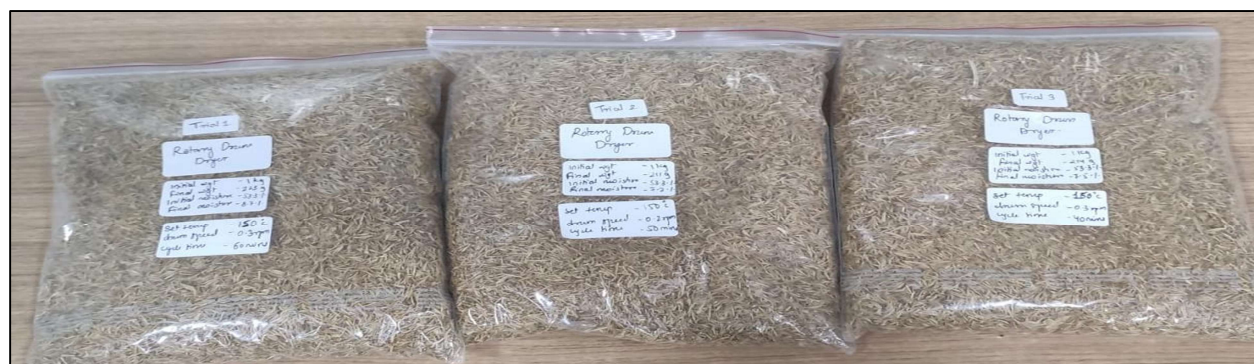
No. of Cycles – 1

Total Cycle time – 40 mins.

**Trials Images:**



**Untreated Sample (Initial sample, Screw pressed sample)**



**Treated Sample (Trial 1, Trial 2, Trial 3)**

**Format: F/R&D/01**

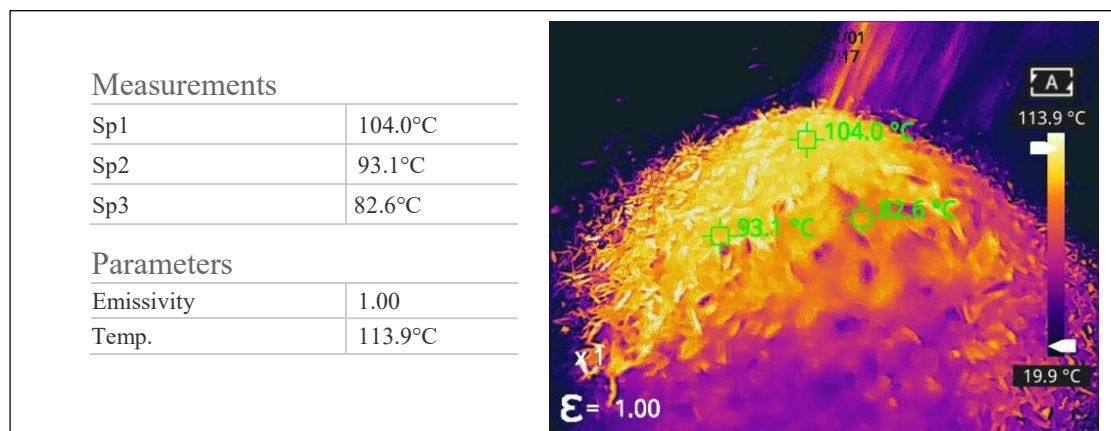
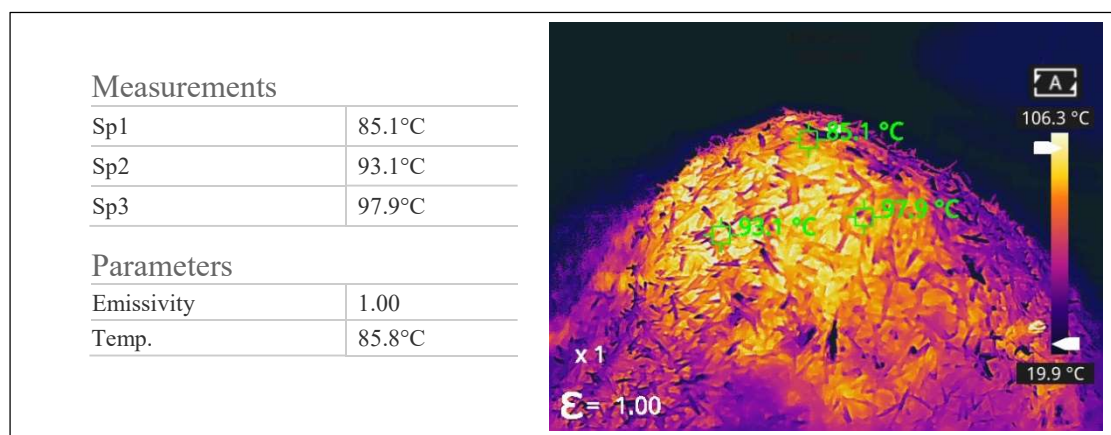
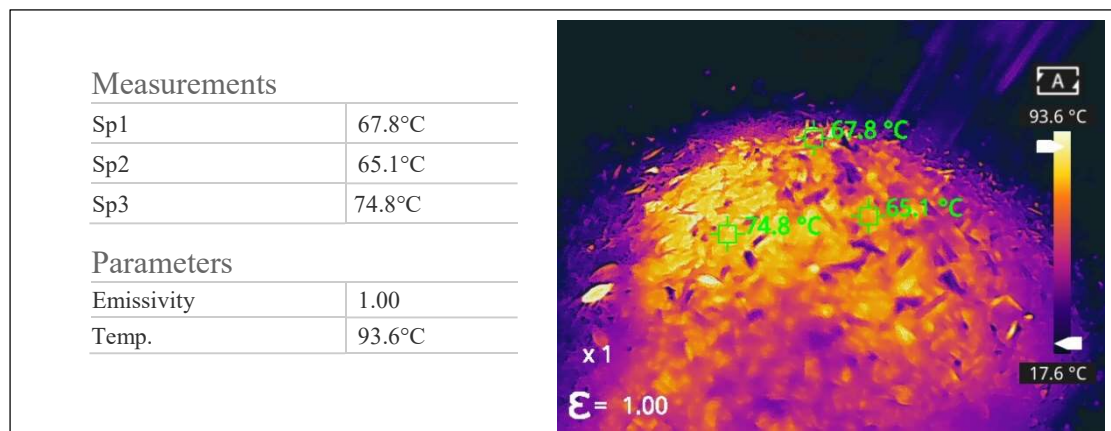
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## Thermal Images:



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**Moisture Analysis Report:**

Drying started	
Date :	23-02-2023
Time :	10:34:24
Model:	AGS200
Serial number :	138
Drying parameters	
Product :	0
Drying temperature :	105.0 °C
Drying profile :	standard
Mode :	Short mode
Calculation :	$\{(m0-m)/m0\} \times 100\%$
Finished :	3 samples
Initial weight :	0.719 g
Final weight :	0.209 g
Drying time :	00:06:20s
Sampling interval :	20 sec
Moisture :	70.9 %
NOTE	Initial moisture
The analysis performed by:	
Signature	<i>[Signature]</i>

Drying started	
Date :	23-02-2023
Time :	11:31:13
Model:	AGS200
Serial number :	138
Drying parameters	
Product :	0
Drying temperature :	105.0 °C
Drying profile :	standard
Mode :	Short mode
Calculation :	$\{(m0-m)/m0\} \times 100\%$
Finished :	3 samples
Initial weight :	0.704 g
Final weight :	0.329 g
Drying time :	00:09:00s
Sampling interval :	20 sec
Moisture :	53.3 %
NOTE	Screw pressed sample moisture.
The analysis performed by:	
Signature	<i>[Signature]</i>



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Trial 1	Trial 2	Trial 3
<p>Drying started</p> <p>Date : 23-02-2023 Time : 14:46:01 Mode : AGS200 Serial number : 138</p> <p>Drying parameters</p> <p>Product : 0</p> <p>Drying temperature : 105.0 °C</p> <p>Drying profile : standard Mode : Short mode Calculation : <math>((m_0 - m)/m_0) \times 100\%</math> Finished : 3 samples</p> <p>Initial weight : 0.506 g Final weight : 0.462 g</p> <p>Drying time : 00:02:00s Sampling interval : 20 sec</p> <p>Moisture : 0.7 %</p> <p>NOTE Final moisture</p> <p>The analysis performed by:</p> <p>Signature: <i>Asoli</i></p>	<p>Drying started</p> <p>Date : 23-02-2023 Time : 11:56:52 Mode : AGS200 Serial number : 139</p> <p>Drying parameters</p> <p>Product : 0</p> <p>Drying temperature : 105.0 °C</p> <p>Drying profile : standard Mode : Short mode Calculation : <math>((m_0 - m)/m_0) \times 100\%</math> Finished : 3 samples</p> <p>Initial weight : 0.585 g Final weight : 0.543 g</p> <p>Drying time : 00:02:00s Sampling interval : 20 sec</p> <p>Moisture : 7.2 %</p> <p>NOTE Final moisture</p> <p>The analysis performed by:</p> <p>Signature: <i>Asoli</i></p>	<p>Drying started</p> <p>Date : 23-02-2023 Time : 15:01:32 Mode : AGS200 Serial number : 138</p> <p>Drying parameters</p> <p>Product : 0</p> <p>Drying temperature : 105.0 °C</p> <p>Drying profile : standard Mode : Short mode Calculation : <math>((m_0 - m)/m_0) \times 100\%</math> Finished : 3 samples</p> <p>Initial weight : 0.544 g Final weight : 0.503 g</p> <p>Drying time : 00:02:00s Sampling interval : 20 sec</p> <p>Moisture : 7.5 %</p> <p>NOTE Final moisture</p> <p>The analysis performed by:</p> <p>Signature: <i>Asoli</i></p>

**Observations:**

The heating behavior of Barley Husk was investigated under the Convection heating system. The heating rate was found to be increasing with respect to increasing in time. As per the physical investigation, it was observed that the product was dried as desired without any charring effect and was seal packed after treatment. Also, the desired moisture content was obtained.

*Asoli*

**Ms. Sayali Asole**  
(Tested By)

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